dergo limb reconstruction after resection of a bone tumor (87% primary union rate) and for forearm or mandibular defects (100% primary union rate). For the most difficult cases of chronic osteomyelitis, 60% of vascularized grafts ultimately heal.

Vascularized bone grafts have the advantage of maintaining a physiologic blood supply, thus not depending on subsequent revascularization; preserving live osteocytes, osteoblasts and osteoclasts, and greater bone strength. Contraindications to microvascular transfer of bone include a patient who is a poor risk for a lengthy operative procedure, a limb with limited salvage potential and where there is a probability of success with a conventional bone graft.

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Immediate Stabilization of Fractures in Patients With Multiple-Systems Injuries

SEVERE HEAD INJURY and uncontrolled hemorrhage remain the primary causes of early death in victims of multiple-systems trauma. If a victim survives the first 24 to 48 hours, the most common cause of death is adult respiratory distress syndrome (ARDS), followed by multiple-systems organ failure and sepsis.

Traditionally, treatment of fractures has been relegated to the lowest priority during the initial treatment phase. Recent evidence suggests, however, that immediate stabilization of unstable fractures of the femur, pelvis and occasionally the spine may play a major role in reducing the morbidity and mortality in these patients. Immediate stabilization of other long bone fractures, such as the humerus, may be indicated as well.

Immediate stabilization of fractures offers many advantages in patients with multiple-systems injuries: Stabilization of fractures significantly reduces pain, which reduces the need for narcotics. Narcotics are respiratory and cerebral depressants, and their use increases the need for ventilatory support and possibly the incidence of ARDS. Fracture stability facilitates nursing care and increases patient mobility, permitting a vertical chest position essential for pulmonary care. Greater patient mobility also lowers the incidence of decubitus ulcers, thrombophlebitis and other phenomena associated with prolonged bed rest. Immediate fracture stability allows joints and muscles to be rehabilitated earlier, resulting in an earlier return to function and a better long-term result from musculoskeletal injuries. A group of patients with immediate stabilization of major fractures was compared with a historical control in which early fracture stabilization was not done. When the injury severity score was between 26 and 40, early fracture stabilization reduced the incidence of ARDS from 32% to 9%, mortality dropped from 9.3% to 3.4% and length of hospital stay was cut by 50%. Others have shown similar outcomes.

Immediate stabilization of fractures in these polytrauma patients can be challenging, as the fractures are often complex and open. One or more surgical teams experienced in the treatment of patients with multiple injuries are usually necessary to achieve immediate stabilization of major fractures without undue morbidity.

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Recent Advances in the Treatment of Chronic Posttraumatic Osteomyelitis of the Tibia

THE PERSISTENCE of bone infection can be attributed to the presence of sequestrum, nonunion of a fracture or retained metal used for internal fixation. Control of bone infection requires debriding all sequestra and surrounding necrotic tissue with the administration of appropriate antimicrobial therapy. In ununited tibial fractures, bone debridement followed by cancellous bone-grafting procedures and external fixation have achieved a high rate of bony union. Following healing of the fracture, infection is more easily managed and in many instances eradicated.

Optimal treatment of chronic osteomyelitis of the tibia is often adversely affected by the absence of an adequate soft tissue envelope. The use of local muscle flaps to reestablish adequate soft tissue coverage improves infection control. In addition, recent advances in microvascular techniques have allowed for the transfer of muscle, myocutaneous, osseous and osteocutaneous flaps to the tissue-deficient site. In our experience, the use of local muscle flaps or vascularized free-tissue transfers, in combination with appropriate orthopedic procedures and antimicrobial therapy, has resulted in an increased success rate in the treatment of this difficult problem.

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Biopsy of Primary Bone Tumors

IN THIS ERA of limb salvage, the "simple" biopsy is a crucial determinant of patient outcome. Precautions relate to the timing of biopsy, the type of biopsy, the direction of incisions, arthroscopic biopsy, the extent of a biopsy and the use and placement of wound suction.

Biopsy trauma alone may increase the apparent tumor extent as seen on imaging studies. Therefore, all local staging procedures—that is, isotope scans, angiograms, computed tomography and magnetic resonance imaging—should be done before the biopsy. An open biopsy is usually best.

Closed biopsy may be useful to diagnose suspected metastases to bone, but histologic diagnosis of primary tumors can be difficult, requiring larger tissue specimens for multiple studies including special stains, immunoperoxidase studies and electron-microscopic evaluation. Frozen section confirmation that representative tissue has been obtained is always advisable. Alignment of biopsy incisions is crucial because the scar must later be resected en bloc with the tumor. Incisions should be vertical on the extremities and transverse only at the pelvic rim and joint flexion creases. Poorly placed incisions can prevent any attempt at preserving a limb and can force amputation. It is suggested that a preliminary biopsy be done only by a physician who is fully qualified to carry out the definitive surgical procedure. Arthroscopic biopsy in the evaluation of joint symptoms due to an adjacent tumor is contraindicated. Transsynovial biopsy of a tumor will seed the entire joint with cells, creating an exceptionally difficult surgical problem.

For a number of reasons, only a peripheral wedge of tumor should be excised to show its type and highest cellular grade. Peripheral tissue is often less mineralized and easier to cut for frozen section. Bleeding is easier to control after a peripheral biopsy than a larger, deeper incision, and further weakening of the bone is avoided. Management of the biopsy site should include rigorous hemostasis and wound suction to help prevent dissemination of tumor cells along adjacent fascial planes. Suction tube(s) are brought out in line with the incision to facilitate later en bloc resection.

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Alternatives to Cemented Joint Prostheses

ALTHOUGH THE CEMENTED total hip replacement has outperformed all other reconstructive procedures for the arthritic hip, ten-year follow-up studies have shown a loosening rate at the bone-cement junction approximating 25%. Additionally, osteolysis, in some part due to the fragmentation of cement and the body's response to this particulate debris, may make further reconstruction difficult. The cementless total hip replacement has been developed to overcome this long-term loosening and osteolysis.

Cementless technology has developed along two conceptual lines. The Europeans have concentrated their efforts on macrointerlock of bone to prosthesis, while North Americans have concentrated on microinterlock of bone to prosthesis. Macrointerlock prostheses, because of their mechanical weakness, relatively high loosening rate and difficulty in removal due to bony ingrowth, have few proponents in this country.

The microinterlock prosthesis is now used rather extensively in this country, especially in the treatment of arthritic problems in younger patients. In the microinterlock system, the prosthesis is coated with beads or wires, creating 200 to 500 micron surface pores on the prosthetic surface for bony ingrowth. Several problems inherent in this technique must be recognized. The process of attaching the porous material to the prosthesis significantly weakens its structure and may cause it to break in the long term. The percentage of pores that actually are ingrown with bone varies substantially in studies, but it appears that only about 30% of the material is actually ingrown with bone. Thus, the question remains whether these devices will actually biologically bond with the femur and the acetabulum. Other problems include low-grade pain and limp, technical difficulty in implanting the prosthesis and stress shielding or resorption of unstressed bone. Despite these cautions, excellent short-term results have been reported.

It is important to continue to develop new concepts and techniques of biologic bonding of prosthesis to bone. Cement has certainly been effective, but osteolysis is of significant concern. Microinterlock shows promise in the short term. What long-term problems it will engender are yet to be seen.

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Orthopedic and Soft Tissue Applications of Magnetic Resonance Imaging

MAGNETIC RESONANCE IMAGING (MRI) is a relatively new noninvasive diagnostic technique that uses magnetic fields and radio-frequency signals to generate cross-sectional representations of internal anatomy. Advantages of the technique include the absence of a known biologic hazard, direct multiplanar imaging capability without sacrifice of spatial resolution and the ability to provide excellent discrimination among various normal and pathologic soft tissue structures. MRI has been shown to provide useful diagnostic insight into various orthopedic disorders, particularly those affecting muscles, tendons, ligaments, articular cartilage and bone marrow.

The method shows greater sensitivity than skeletal scintigraphy in the early diagnosis of ischemic necrosis involving the femoral head and has shown promising preliminary results in the evaluation of this disease at other sites. Owing to its extreme sensitivity for pathologic processes that begin in bone marrow, MRI can also contribute to the early diagnosis of acute hematogenous osteomyelitis, metastatic disease to the skeleton and myeloproliferative disorders. In the staging of primary osseous neoplasms, the technique is superior to computed tomography (CT) in determining the degree of marrow involvement and soft tissue extension, although cortical bone destruction and matrix calcification or ossification are slightly less well depicted.

MRI has contrast discriminating capabilities that offer advantages over CT, particularly in establishing the precise extent of primary soft tissue pathology, including infection and neoplastic disease. In cases of severe trauma, especially those involving the knee joint, the method can reliably diagnose meniscal damage, cruciate and collateral ligament tears, articular cartilage pathology and intra-articular effusion. MRI may eventually replace arthrography and CT in the evaluation of internal derangements affecting the temporomandibular